POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1939	*h m*		°	°	°	°				
Apr. 29	10 41	6418	−76	117	+11	77	388	7	VG	Mount Wilson.
		6417	−42	151	−11	42	97	12		
		6414	−39	154	−20	41	48	9		
		6413	−34	159	+21	41	194	25		
		6415	−31	162	+12	35	24	3		
		6416	−7	186	+31	35	24	8		
		6410	+8	201	−11	11	242	30		
		6412	+31	224	−11	32	48	15		
		6406	+41	234	−15	42	776	30		
		6407	+42	235	+30	53	630	20		
		6408	+47	240	+5	48	97	1		
		6405	+55	248	+23	60	145	3		
		6409	+85	278	−13	84	242	7		
				(193)	(−4)		2,955	170		
Apr. 30	9 0	6418	−63	118	+12	64	776	15	VG	Do.
		6419	−43	138	−15	44	48	9		
		6414	−38	143	−21	40	97	10		
		6417	−29	152	−11	30	121	15		
		6414	−28	153	−21	33	61	15		
		6413	−21	160	+20	31	170	30		
		6415	−19	162	+11	24	48	5		
		6410	+19	200	−11	21	145	12		
		6412	+44	225	−11	44	48	4		
		6407	+54	235	+30	61	630	16		
		6406	+54	235	−15	54	485	21		
		6408	+60	241	+44	61	97	1		
		6405	+68	249	+22	70	73	4		
				(181)	(−4)		2,799	157		

Mean daily area for 30 days=2,133.
*Not numbered.
Plate quality=F=fair; G=good; VG=very good; P=poor.

PROVISIONAL SUNSPOT RELATIVE NUMBERS FOR APRIL 1939

[Dependent alone on observations at Zurich]

[Data furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich, Switzerland]

April 1939	Relative numbers	April 1939	Relative numbers	April 1939	Relative numbers
1	*Ec* 34	11	*a* 103	21	125
2	*Mc* 85	12	*a* 100	22	*a* 115
3	83	13	*EWcc* 112	23	*Macd* 152
4	*a* 82	14	*Eaac* 126	24	151
5	74	15	*b* 121	25	*a* 134
6	*ad* 70	16	*d* 141	26	*abd* 134
7	*Ecd* 63	17	109	27	----------
8	----------	18	102	28	*ad* --
9	*dd* 89	19	*ad* 94	29	----------
10	*Wc* 98	20	*Macdd* 125	30	140

Mean, 26 days=106.2

Middle, large bright chromospheric eruption observed— U. T.

	h	m	h	m	
April 16	8	33 to	9	45	M.
April 16	8	35	9	50	W.
April 21	9	00	9	20	E.
April 22	8	25	8	45	M.
April 24	11	15	11	30	W.

a=Passage of an average-sized group through the central meridian.
b=Passage of a large group through the central meridian.
c=New formation of a group developing into a middle-sized or large center of activity: E, on the eastern part of the sun's disk; W, on the western part; M, in the central-circle zone.
d=Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE in charge]

By B. FRANCIS DASHIELL

The 362 airplane and 233 radiosonde upper-air observations shown in tables 1 and 1a for the month of April also include the first of a series of radiosonde reports from Bermuda. Of all observations made exclusively within the United States, 96 percent and 85 percent reached 4 and 5 kilometers, respectively. Radiosonde observations showed some improvement, with 97, 92, 73, and 38 percent of all flights reaching 5, 10, 15, and 18 kilometers, respectively, while a few individual ascents rose to 23 kilometers. At Oakland, Calif., and Washington, D. C., 50 percent and 47 percent, respectively, of all flights launched at the surface attained 18 kilometers. The April wind resultants include those from 3 new pilot balloon stations operating at Des Moines, Iowa, Milwaukee, Wis., and Pueblo, Colo. A detailed explanation of tables 1, 1a, 2, 3, and 4, and charts VIII, IX, X, XI, and XII, will be found in the January 1939 issue of the MONTHLY WEATHER REVIEW.

The weather in April was in contrast with that which prevailed during March over the eastern half of the country. As shown on chart I, mean surface temperatures (° F.) were subnormal east of the Mississippi Valley with the coldest weather over the Great Lakes region, and abnormal temperatures occurred over Nevada and the interior of California. Above the surface, in the free air, the mean temperatures (° C.) for April were lowest over Sault Ste. Marie, Mich., and Fargo, N. Dak., at all levels up to 8 kilometers; over Fargo, N. Dak., from 9 to 12 kilometers; over Oklahoma City, Okla., from 13 to 18 kilometers; and over Oklahoma City, Okla., and Oakland, Calif., at 19 and 20 kilometers. However, the lowest mean temperatures for the current month were recorded over Bermuda, between 12 and 18 kilometers.

A minimum upper-air mean temperature of —69.5° C. was reported from Bermuda, while the lowest for the United States (—63.2° C.) was recorded at Oklahoma City, Okla.; both occurring at 17 kilometers. Highest mean temperatures for the month were recorded over Pensacola, Fla., at 0.5, 1, and 5 kilometers; over El Paso, Tex., at all levels from 1.5 to 4 kilometers; at Oakland, Calif., from 6 to 9 kilometers; over Nashville, Tenn., at 10 and 11 kilometers; and over Sault Ste. Marie, Mich., from 12 to 20 kilometers, inclusive.

The April mean free-air temperatures listed in tables 1 and 1a were seasonally higher at all levels up to 5 kilometers than during March. At the 5-kilometer level the current month was cooler than April 1938, except over stations in the far Northwest and in California. Above 5 kilometers at all stations April was warmer than the preceding month, but Oakland, Calif., became cooler in the levels higher than 10 kilometers.

A center of low mean pressure was indefinitely located north of the Great Lakes region and northeast toward Newfoundland, as shown on charts VIII, IX, X, and XI. At these same levels high pressure prevailed over Bermuda and extended westward in a belt to Pensacola, Fla., El Paso, Tex., and San Diego, Calif. Pressures during April were slightly higher in the North and lower in the South than in March. The pressure differences between the "high" and "low" areas, or gradient between Sault Ste. Marie, Mich., and Pensacola, Fla., at each level, increased with altitude up to 5 kilometers, but were found to be less than the differences noted in March.

Mean relative humidity, from the surface up to 8 kilometers, was highest over Sault Ste. Marie, Mich., and

comparatively high over Washington, D. C., at all levels above 4 kilometers. Bermuda reported high humidity at 0.5, 1, 1.5, and 2 kilometers, but at the higher levels the air was much drier. The driest air in the lower levels appeared over El Paso, Tex., and Norfolk, Va.; and over Oakland, Calif., Oklahoma City, Okla., and Bermuda, at all levels above 5 kilometers.

The April resultant winds, based on 5 a. m. and 5 p. m. observations, as shown on charts VIII, IX, X, and XI, showed northwesterly directions at 1.5 kilometers except for an area that extended from Texas to the Atlantic, and another in the far Northwest. At 3, 4, and 5 kilometers the directions were northwesterly except over the extreme southeastern portion of the United States, and Cuba and Mexico. At the four levels shown by the charts, winds from the northwest quadrant prevailed in 55, 79, 83, and 87 percent of all cases at 1.5, 3, 4, and 5 kilometers respectively. Even at the highest levels some southwesterly winds persisted. The April resultant wind directions were slightly north of those recorded in March, and this was particularly noticeable over the eastern half of the country at 3 kilometers.

Comparing the April 5 a. m. (E. S. T.) resultant wind directions at 1.5 and 3 kilometers (charts VIII and IX) with normal directions computed for the same levels at 24 well-distributed stations, it was found that most of the current winds departed from the normal directions by a clockwise rotation. However, outstanding exceptions occurred at Key West, Fla., and Atlanta, Ga., where the departures from normal were oriented by a counterclockwise rotation. Medford, Oreg., and Oakland, Calif., showed the largest degree of clockwise departures at 1.5 kilometers. Using these 5 a. m. normals in comparison with 5 p. m. observations at 4 and 5 kilometers (charts X and XI), it was found that large counterclockwise departures existed over Key West, Fla., and Medford, Oreg. Large clockwise departures were noted over Salt Lake City, Utah, at 3 and 4 kilometers. Resultant velocities for April were greater than normal at most of the stations for which normals have been computed, particularly over the Central States. The highest departure noted was +9.4 m. p. s. over Seattle, Wash., at 5 kilometers.

Table 2 shows 5 p. m. (E. S. T.) resultant wind directions and velocities at a number of selected stations at all levels. Comparing 20 of these stations with their 5 a. m. normals, it was found that clockwise departures occurred at all levels over Cheyenne, Wyo., and counterclockwise departures at Sault Ste. Marie, Mich., and Washington, D. C. The most outstanding departures were noted at Salt Lake City, Utah, Omaha, Nebr., Medford, Oreg., Seattle, Wash., and Fargo, N. Dak.; while the winds at Chicago, Ill., Oakland, Calif., and St. Louis, Mo., were about normal. Resultant velocities were higher than normal in most cases, except at Cheyenne, Wyo., and San Diego, and Oakland, Calif. There were excessive velocities at Omaha, Nebr., and Seattle, Wash., being as much as +8.4 m. p. s. over the latter station at 5 kilometers.

The resultant winds for April, as shown in table 2, when compared to the winds of the previous month, showed higher velocities during April at most stations with the exception of Winslow, Ariz., Las Vegas, Nev., Havre, Mont., Fargo, N. Dak., Billings, Mont., Abilene, Tex., Albuquerque, N. Mex., Oklahoma City, Okla., St. Louis, Mo., and Chicago, Ill. The April resultant velocities at Medford, Oreg., and Miami, Fla., were considerably higher at all levels (up to 12 kilometers at the former) than during March. At Chicago, Ill., Fargo, N. Dak., Oklahoma City, Okla., St. Louis, Mo., and Winslow, Ariz., the March directions generally were south of (counterclockwise rotation) the April directions, and the wind velocities were higher.

The resultant winds for April at 1.5 and 3 kilometers (table 2) based on 5 p. m. observations, when compared with the current winds (charts VIII and IX) based on 5 a. m. observations, showed that the morning directions were definitely more northerly than the 5 p. m. directions. The 5 a. m. velocities, too, were slightly higher in most cases. However, at Miami, Fla., the 5 a. m. resultant directions were more southerly than at 5 p. m. at both levels by an average of 28°, and the resultant velocities lower by an average of −1.8 m. p. s.

The maximum altitudes reached by pilot balloons were 17,757 meters at Denver, Colo., and 17,556 meters at Omaha, Nebr. Altitudes over 15 kilometers were reached at 13 stations; from 10 to 15 kilometers at 39 stations, from 5 to 10 kilometers by 31 stations; and only one station failed to reach 5 kilometers. Maximum altitudes during April were somewhat higher than those reached in March, being confined to the Great Lakes region, Ohio Valley, New England, Texas, the southern Rocky Mountain region and southern Pacific coast. Practically all maximum altitudes were reached during the closing days of April—on the 28th over the northern Rocky Mountains, on the 29th over the north-central States and Upper Mississippi Valley, and on the 30th over the lower Ohio and Mississippi Valleys.

Table 3 shows the maximum wind velocities that occurred over the United States during April. Some relatively high wind speeds were recorded between the surface and 2.5 kilometers, the greatest being 51.4 m. p. s. from the north on the 5th, over Sandberg, Calif. This station also reported a maximum wind between 2.5 and 5 kilometers (56.1 m. p. s.) on the 5th. Above 5 kilometers, a maximum velocity of 80 m. p. s. from the northwest (179 miles per hour) occurred over Redding, Calif., on the 4th, at 13,270 meters. These velocities appear to be the highest recorded in the upper air over California in the levels below 2.5 kilometers, and above 5 kilometers.

The mean insentropic chart [1] for April shows two moist tongues: One enters the country in Texas and curves anticyclonically to the northeast and east. This tongue was present on about one-third of the days, which is not characterized by winds blowing along its axis. The precipitation excess above normal in the Northeastern States seems to be associated with this moist tongue. Another moist tongue was off the Atlantic coast, also on about one-third of the days; its northern portion was located by means of 22 daily radiosondes released by the International Ice Patrol cutters S. S. *Champlain* and S. S. *Chelan* at about latitude 44.5° N., longitude 48.5° W. In the west, the effect of the plateau is seen in the northward bulge of the contour and moisture lines.

[1] This chart and the following discussion have been prepared by the Air Mass Section of the Meteorological Research Division.

TABLE 1.—*Mean free-air barometric pressures (P.) in mb., temperatures (T.) in °C., and relative humidities (R. H.) in percent obtained by airplanes during April 1939*

Stations and elevations in meters above sea level	Altitude (meters) m. s. l.																											
	Surface				500			1,000			1,500			2,000			2,500			3,000			4,000			5,000		
	Number of observations	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.
Billings, Mont. (1,090 m.)	30	892	5.6	61							849	6.7	53	798	3.8	53	750	0.2	56	705	−3.4	58	620	−9.9	59	544	−16.2	57
Cheyenne, Wyo. (1,873 m.)	29	810	2.4	72										797	4.5	62	750	2.9	56	705	−0.6	53	621	−7.9	55	545	−15.9	56
Chicago, Ill. (187 m.)	30	991	4.7	77	954	5.5	66	897	3.8	64	843	1.2	64	792	−1.2	60	744	−3.4	54	698	−6.0	50	614	−10.9	48	538	−17.1	49
Coco Solo, C. Z.[1] (15 m.)	29	1,012	26.0	86	958	22.5	94	905	19.6	91	854	17.2	82	805	15.1	70	759	13.2	54	715	10.6	49	634	5.4	39			
El Paso, Tex. (1,193 m.)	30	881	13.8	36							850	15.6	32	800	13.0	31	754	10.0	30	710	6.4	31	627	−1.1	33	552	−8.6	36
Lakehurst, N. J.[1] (39 m.)	23	1,011	5.0	74	955	5.8	67	898	2.9	67	844	0.6	69	793	−1.8	69	744	−3.8	69	699	−5.9	67	614	−11.1	62			
Norfolk, Va.[1] (10 m.)	18	1,017	10.8	76	959	11.4	47	903	8.5	46	849	5.1	50	799	2.8	46	751	0.7	40	705	−2.2	39	621	−6.8	29	546	−13.3	27
Pearl Harbor, T. H.[1] (6 m.)	30	1,016	20.5	80	960	19.1	76	906	15.9	78	853	13.4	76	804	11.2	67	756	8.9	61	712	6.9	54	630	2.1	41			
Pensacola, Fla.[1] (13 m.)	30	1,017	15.8	89	960	16.0	75	905	14.7	67	853	12.0	65	803	9.7	56	756	7.6	47	711	4.6	45	628	−1.4	35	554	−7.7	34
St. Thomas, V. I.[1] [2] (8 m.)																												
Salt Lake City, Utah (1,288 m.)	30	871	7.1	63							850	10.1	52	800	7.6	51	752	4.2	52	707	0.6	55	623	−6.1	57	548	−12.4	56
San Diego, Calif.[1] (10 m.)	27	1,016	14.4	80	958	13.3	77	904	14.7	60	852	13.3	50	802	11.7	41	755	8.7	36	710	5.2	34	627	−1.3	31	552	−9.3	28
Seattle, Wash.[1] (10 m.)	26	1,019	10.7	67	961	8.1	66	904	5.5	65	851	3.2	61	800	0.7	55	751	−1.2	49	706	−3.7	47	620	−9.2	40			
Spokane, Wash. (597 m.)	30	947	6.3	69				902	9.4	52	849	6.6	50	799	2.8	52	751	−0.7	54	705	−4.0	52	621	−9.7	53	544	−15.5	55

[1] Navy.
[2] Flights discontinued temporarily.

Observations taken about 4 a. m. 75th meridian time, except by Navy stations along the Pacific coast and Hawaii where they are taken at dawn.
NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.

TABLE 1a.—*Mean free-air barometric pressures (P) in mb., temperatures (T) in °C., and relative humidities (R H) in percent obtained by radiosonde during April 1939*

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																											
	Bermuda[2] (50 m.)				Fargo, N. Dak. (274 m.)				Nashville, Tenn. (180 m.)				Oakland, Calif. (2 m.)				Oklahoma City, Okla. (391 m.)				Omaha, Nebr. (300 m.)				Sault Ste. Marie, Mich. (221 m.)				Washington, D. C.[1] (13 m.)			
	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity	Number of observations	Pressure	Temperature	Relative humidity
Surface	24	1,016	17.9	87	30	981	1.0	80	30	994	10.1	78	30	1,018	10.4	89	29	969	11.3	65	30	979	7.4	69	30	986	−1.6	85	30	1,015	9.2	73
500	24	964	16.0	86	30	954	2.7	76	30	957	10.4	70	30	959	10.4	78	29	956	12.1	62	30	955	7.7	65	30	952	−1.2	83	30	956	7.4	65
1,000	24	909	12.4	85	30	897	1.1	71	30	901	8.3	69	30	903	11.9	56	29	901	11.8	55	30	899	6.0	63	30	894	−2.1	78	30	899	5.0	68
1,500	24	856	9.5	75	30	842	−1.2	68	30	847	5.7	65	30	851	10.4	45	29	848	9.3	53	30	845	4.1	62	30	839	−4.3	77	30	845	2.5	70
2,000	24	805	7.0	69	30	791	−3.2	66	30	797	3.8	63	30	800	7.7	40	29	798	6.8	50	30	795	1.6	59	30	787	−6.6	76	30	794	0.6	67
2,500	24	758	5.3	58	30	743	−5.2	63	30	749	1.7	61	30	753	4.8	39	29	751	4.8	48	30	746	−1.2	58	30	738	−8.9	72	30	746	−1.6	66
3,000	24	712	2.6	52	30	696	−7.9	62	28	704	−1.3	63	30	708	2.2	38	29	706	1.8	46	30	701	−4.1	57	30	692	−11.4	69	30	700	−4.2	65
4,000	24	629	−2.9	43	30	612	−13.8	61	27	620	−5.8	59	30	625	−3.6	35	28	623	−4.2	40	30	617	−9.2	53	30	606	−16.7	65	30	616	−9.4	64
5,000	24	554	−9.1	40	30	535	−20.0	57	27	545	−11.8	56	30	550	−9.9	33	28	548	−11.2	39	29	541	−15.5	50	29	530	−23.2	63	30	541	−14.9	59
6,000	24	486	−15.6	39	30	467	−26.8	55	26	478	−18.2	55	30	482	−17.1	31	28	480	−18.1	40	29	473	−22.5	47	29	462	−29.7	60	30	473	−21.2	58
7,000	24	425	−22.8	38	30	406	−34.0	54	25	417	−25.2	54	30	421	−24.3	31	27	419	−25.8	40	26	412	−30.0	46	28	400	−36.3	59	30	412	−27.4	57
8,000	24	370	−30.5	37	30	351	−41.6	54	25	362	−32.1	52	30	366	−31.7	31	26	365	−33.1	39	26	357	−37.6	45	28	346	−42.6	60	30	358	−34.3	57
9,000	24	320	−38.4	36	30	302	−48.3		25	314	−39.4	52	30	317	−39.3	30	25	315	−40.4	37	26	308	−45.1		28	298	−48.1		30	310	−41.1	56
10,000	24	276	−46.3		29	259	−54.3		25	270	−46.2		30	274	−46.5		25	272	−47.7		25	265	−50.7		28	255	−52.0		30	267	−47.2	
11,000	24	237	−54.1		28	221	−58.1		25	232	−51.9		30	235	−53.2		25	233	−54.1		25	227	−55.1		28	219	−54.3		30	229	−52.3	
12,000	24	202	−60.2		27	188	−59.3		24	199	−55.6		30	201	−58.1		25	199	−59.0		25	194	−58.1		27	187	−54.7		27	196	−56.0	
13,000	24	172	−63.8		25	160	−59.3		23	170	−57.8		28	171	−60.4		24	169	−61.9		25	165	−59.2		26	160	−54.8		26	167	−57.7	
14,000	24	146	−64.5		24	136	−58.5		23	144	−57.7		28	146	−60.4		23	144	−61.3		25	140	−58.6		25	137	−54.8		24	143	−58.1	
15,000	21	124	−66.4		20	116	−59.0		20	123	−58.6		28	124	−59.9		17	123	−61.3		20	120	−59.3		24	117	−55.6		23	122	−58.5	
16,000	18	105	−69.2		16	98	−59.2		18	105	−59.4		27	106	−60.6		13	104	−63.0		16	102	−60.0		22	100	−56.6		21	103	−59.0	
17,000	13	88	−69.5		13	83	−58.5		16	89	−60.2		21	90	−60.7		11	89	−63.2		11	86	−60.5		14	85	−57.1		18	88	−59.4	
18,000	8	75	−66.6		7	70	−58.4		10	75	−60.6		15	76	−61.3		9	75	−63.1		6	73	−60.5		11	72	−57.3		14	74	−59.3	
19,000	6	63	−61.7						6	64	−59.4		8	65	−61.9		7	64	−62.8						9	62	−57.8		9	63	−59.1	
20,000													5	55	−61.9		5	54	−62.3						5	52	−57.5					

[1] Navy.
[2] Operated by Massachusetts Institute of Technology.

Observations taken about 4 a. m. 75th meridian time, except by Navy stations along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.
Number of observations refers to pressure only as temperature and humidity data are missing for some observations at certain levels, also, the humidity data are not used in daily observations when the temperature is below −40° C.

TABLE 2.—*Free-air resultant winds based on pilot-balloon observations made near 5 p. m. (E. S. T.) during April 1939*

[Directions given in degrees from North (N=360°, E=90°, S=180°, W=270°)—Velocities in meters per second (superior figures indicate number of observations)]

Altitude (meters) m. s. l.	Abilene-Tex. (537 m.)		Albuquerque, N. Mex. (1,554 m.)		Atlanta, Ga. (302 m.)		Billings, Mont. (1,095 m.)		Boise, Idaho (850 m.)		Brooklyn, N. Y. (15 m.)		Brownsville, Tex. (7 m.)		Buffalo, N. Y. (220 m.)		Burlington, Vt. (132 m.)		Charleston, S. C. (18 m.)		Cheyenne, Wyo. (1,873 m.)		Chicago, Ill. (192 m.)		Cincinnati, Ohio (157 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	307	0. 4[30]	240	1. 5[30]	260	3. 0[30]	314	2. 2[30]	299	2. 1[30]	256	4. 0[27]	128	5. 0[29]	251	4. 5[28]	299	1. 5[24]	214	3. 0[30]	292	4. 0[27]	262	2. 4[27]	261	3. 0[29]
500					258	4. 3[30]					260	6. 3[27]	135	4. 9[29]	264	6. 9[28]	276	2. 6[23]	214	5. 2[29]			258	3. 6[27]	253	5. 7[29]
1,000	287	0. 5[30]			258	5. 2[29]			306	3. 1[30]	264	8. 0[26]	169	2. 9[25]	258	7. 7[24]	273	3. 9[23]	235	6. 8[28]			268	4. 6[23]	252	7. 0[29]
1,500	213	1. 4[28]			252	5. 8[28]	307	2. 6[29]	297	3. 2[30]	274	10. 2[25]	193	1. 6[23]	258	8. 6[17]	263	4. 6[21]	246	8. 0[28]			271	7. 0[20]	254	7. 7[26]
2,000	241	2. 7[27]	230	2. 7[30]	260	7. 0[27]	311	4. 2[29]	300	3. 6[30]	280	12. 7[22]	275	2. 2[20]	268	8. 7[15]	274	5. 4[16]	258	10. 4[26]	293	4. 4[27]	283	9. 3[13]	269	7. 8[18]
2,500	268	4. 6[24]	248	3. 3[30]	277	9. 3[24]	297	5. 4[27]	307	4. 1[30]	287	15. 1[18]	268	3. 7[19]	269	9. 9[12]	285	7. 3[16]	262	12. 2[25]	299	6. 4[27]	290	10. 3[13]	295	10. 1[11]
3,000	277	6. 9[23]	256	4. 2[30]	270	11. 5[22]	285	7. 0[23]	299	5. 2[29]			289	6. 6[18]			293	9. 0[12]	263	13. 0[21]	293	7. 8[26]	306	11. 0[11]		
4,000	278	9. 7[23]	279	7. 8[26]	281	13. 5[18]	281	7. 5[18]	286	7. 3[22]			276	10. 9[18]					266	16. 2[15]	291	9. 0[23]				
5,000	284	12. 9[20]	287	12. 3[24]	289	12. 4[11]	295	9. 9[14]	293	7. 4[16]			282	13. 0[10]					268	15. 2[11]	306	9. 2[13]				
6,000	291	14. 3[17]	292	16. 0[22]			293	8. 7[12]																		
8,000	291	16. 8[15]	295	20. 5[15]																						
10,000	293	16. 3[10]	303	22. 8[13]																						

Altitude (meters) m. s. l.	El Paso, Tex. (1,196 m.)		Fargo, N. Dak. (283 m.)		Greensboro, N. C. (271 m.)		Havre, Mont. (766 m.)		Houston, Tex. (21 m.)		Huron, S. Dak. (393 m.)		Las Vegas, Nev. (570 m.)		Little Rock, Ark. (82 m.)		Medford, Oreg. (410 m.)		Miami, Fla. (10 m.)		Minneapolis, Minn. (261 m.)		Nashville, Tenn. (194 m.)		New Orleans, La. (19 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	245	2. 3[20]	346	1. 4[29]	242	2. 9[29]	288	2. 2[28]	142	1. 7[29]	337	3. 5[20]	96	1. 0[30]	160	1. 0[29]	318	2. 3[30]	130	3. 2[30]	304	2. 5[28]	250	2. 4[30]	262	0. 1[30]
500			354	4. 2[29]	251	4. 2[29]			164	2. 5[29]	341	4. 0[30]			201	2. 3[29]	315	2. 6[30]	143	3. 3[30]	312	2. 9[28]	229	3. 3[30]	189	2. 4[30]
1,000			347	3. 6[27]	250	5. 8[29]	271	3. 8[28]	234	1. 4[28]	334	3. 9[29]	107	0. 8[30]	240	3. 4[26]	298	2. 2[30]	198	2. 4[27]	282	3. 2[26]	237	4. 5[30]	216	2. 8[26]
1,500	254	3. 1[30]	331	4. 3[26]	254	7. 2[29]	267	3. 8[29]	289	2. 9[24]	313	4. 9[27]	184	0. 4[30]	260	5. 7[29]	266	1. 5[30]	230	2. 9[24]	271	5. 3[26]	250	6. 1[30]	247	3. 3[25]
2,000	265	3. 0[30]	325	5. 3[21]	267	9. 7[29]	275	4. 5[24]	285	6. 1[21]	304	5. 9[26]	245	2. 2[30]	273	6. 9[26]	238	2. 2[30]	255	4. 0[20]	278	6. 4[22]	256	7. 3[27]	262	5. 3[23]
2,500	268	2. 9[30]	324	6. 0[19]	275	13. 4[24]	277	6. 1[19]	280	7. 1[20]	312	8. 5[24]	257	3. 1[30]	284	7. 4[23]	237	3. 4[29]	264	5. 3[15]	296	6. 3[14]	263	8. 3[25]	278	6. 5[23]
3,000	267	4. 3[29]	323	6. 1[15]	274	15. 9[20]	288	7. 1[16]	277	9. 2[19]	313	10. 9[23]	292	2. 3[28]	286	9. 0[20]	244	4. 7[29]	265	7. 2[16]	319	9. 7[10]	275	10. 4[21]	282	7. 1[30]
4,000	266	6. 9[28]	320	9. 0[12]	268	18. 6[18]	290	9. 6[11]	293	8. 6[16]	321	11. 3[17]	289	3. 7[26]	284	12. 8[16]	251	7. 1[27]	251	6. 5[12]			272	13. 2[18]	290	9. 0[16]
5,000	264	8. 9[24]			292	18. 1[10]	282	9. 2[10]	295	10. 7[13]	324	13. 8[18]	288	4. 8[27]	296	14. 3[12]	258	8. 7[26]							304	12. 2[10]
6,000	276	11. 4[20]							297	12. 1[13]	316	14. 2[12]	316	8. 4[28]			260	10. 5[24]								
8,000	294	13. 7[10]									306	15. 9[10]	314	10. 5[20]			272	11. 2[17]								
10,000													322	14. 7[17]			255	10. 4[13]								
12,000													310	14. 4[14]			240	12. 5[10]								

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)		Oklahoma City, Okla. (402 m.)		Omaha, Nebr. (306 m.)		Reno, Nev. (1,346 m.)		St. Louis, Mo. (170 m.)		Salt Lake City, Utah (1,294 m.)		San Diego, Calif. (15 m.)		San Juan, P. R. (16 m.)		Sault Ste. Marie, Mich. (198 m.)		Seattle, Wash. (14 m.)		Spokane, Wash., (603 m.)		Washington, D. C. (10 m.)		Winslow, Ariz. (1,488 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	260	5. 5[27]	246	0. 9[29]	315	3. 6[28]	249	1. 8[30]	233	1. 5[28]	308	3. 0[30]	279	4. 0[29]	84	6. 7[30]	301	3. 4[26]	251	2. 4[29]	239	3. 0[30]	271	1. 6[29]	263	3. 3[30]
500	290	3. 7[28]	242	1. 1[29]	310	3. 9[28]			260	2. 7[28]			293	2. 4[29]	97	9. 5[30]	315	4. 6[26]	236	2. 3[29]			246	4. 6[29]		
1,000	301	2. 6[28]	244	2. 2[29]	312	5. 2[29]			252	4. 5[26]			316	2. 3[23]	109	7. 7[30]	313	3. 4[23]	212	3. 2[27]	234	3. 0[30]	247	7. 3[28]		
1,500	304	2. 6[28]	258	3. 2[29]	293	6. 0[25]	248	1. 7[30]	259	5. 7[24]	308	3. 2[30]	339	1. 1[23]	112	6. 0[29]	299	3. 4[22]	185	4. 0[23]	236	3. 6[29]	254	9. 5[26]		
2,000	291	2. 4[28]	275	4. 9[27]	289	7. 8[24]	235	1. 6[30]	275	7. 8[20]	289	2. 5[30]	16	1. 1[21]	118	4. 7[18]	288	5. 0[20]	207	4. 5[21]	238	5. 4[26]	263	10. 7[23]	248	3. 0[30]
2,500	267	1. 8[28]	270	6. 4[24]	289	10. 1[24]	249	2. 1[30]	288	8. 9[17]	256	3. 3[29]	349	1. 6[20]	128	3. 6[14]	297	8. 5[19]	225	5. 5[18]	253	5. 7[22]	268	13. 3[22]	253	3. 4[30]
3,000	280	2. 1[28]	277	8. 0[26]	289	10. 2[21]	260	3. 3[29]	292	10. 2[16]	250	3. 8[25]	347	2. 0[17]	157	2. 9[10]	299	9. 3[17]	239	5. 8[17]	263	5. 5[19]	273	16. 3[16]	253	3. 7[30]
4,000	285	4. 6[26]	277	10. 6[20]	299	12. 5[16]	289	4. 9[28]	291	15. 0[12]	294	3. 8[21]	321	3. 9[16]			302	12. 8[11]	284	10. 2[12]	278	6. 7[17]			280	4. 9[28]
5,000	285	7. 0[23]	282	14. 0[20]	297	15. 6[16]	287	5. 8[26]			307	4. 1[13]	294	6. 0[13]					285	12. 9[10]	287	10. 2[14]			294	6. 6[25]
6,000	281	9. 0[22]	289	14. 8[16]	305	17. 9[13]	292	8. 6[23]					291	9. 3[11]											312	8. 5[23]
8,000	264	12. 8[14]	308	18. 5[10]			301	9. 9[17]																	308	14. 4[19]
10,000							312	8. 8[13]																	290	20. 3[18]

TABLE 3.—*Maximum free-air wind velocities, (M. P. S.), for different sections of the United States based on pilot balloon observations during April 1939*

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station
Northeast [1]	42.0	WNW	1,690	3	Kylertown, Pa.	45.6	SW	3,590	10	Columbus, Ohio	57.0	NW	6,720	3	Cleveland, Ohio.
East-Central [2]	39.1	SSW	1,720	10	Nashville, Tenn.	48.4	WNW	4,530	12	Knoxville, Tenn.	49.6	NNW	7,020	4	Greensboro, N. C.
Southeast [3]	36.8	SW	2,500	19	Charleston, S. C.	40.5	SW	3,710	19	Charleston, S. C.	43.0	WSW	12,170	23	Charleston, S. C.
North-Central [4]	43.6	W	1,970	25	Minneapolis, Minn.	40.6	NNW	4,670	12	Minneapolis, Minn.	46.1	NNW	11,550	21	Huron, S. Dak.
Central [5]	41.9	SW	2,500	9	Evansville, Ind.	52.0	SW	2,930	9	Evansville, Ind.	52.8	W	11,240	9	Wichita, Kans.
South-Central [6]	40.0	NW	1,840	16	Del Rio, Tex.	35.0	NW	4,310	1	Memphis, Tenn.	41.4	W	5,210	7	Little Rock, Ark.
Northwest [7]	30.1	NW	2,500	5	Boise, Idaho.	39.0	NW	4,830	15	Spokane, Wash.	45.2	W	17,380	28	Billings, Mont.
West-Central [8]	38.6	SSW	2,470	13	Modena, Utah.	48.0	NW	5,000	7	Rock Springs, Wyo.	80.0	NW	13,270	4	Redding, Calif.
Southwest [9]	51.4	N	2,500	5	Sandberg, Calif.	56.1	N	2,550	5	Sandberg, Calif.	55.2	NW	5,920	10	Albuquerque, Mex.

[1] Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and northern Ohio.
[2] Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee, and North Carolina.
[3] South Carolina, Georgia, Florida, and Alabama.
[4] Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.
[5] Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.
[6] Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.
[7] Montana, Idaho, Washington, and Oregon.
[8] Wyoming, Colorado, Utah, northern Nevada, and northern California.
[9] Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

TABLE 4.—*Mean altitudes and temperatures of significant points identifiable as tropopauses during April 1939, classified according to the potential temperatures (10-degree intervals between 290° and 399° A.) with which they are identified. (Based on radiosonde observations.)*

Potential temperatures	Fargo, N. Dak.			Nashville, Tenn.			Oakland, Calif.			Oklahoma City, Okla.			Omaha, Nebr.			Sault Ste. Marie, Mich.			Washington, D. C.		
	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.	Number of cases	Mean altitude (km.) m. s. l.	Mean temperature ° C.
290–299	5	7.9	−55.6													4	6.8	−46.2			
300–309	5	8.0	−48.8							1	7.7	−46.0	3	7.8	−46.0	9	8.0	−50.7	1	9.1	−56.0
310–319	15	9.6	−57.0	4	8.5	−41.8	2	8.1	−40.0	6	9.1	−48.3	7	8.9	−49.1	14	9.2	−52.6	3	8.5	−45.0
320–329	14	10.9	−61.9	12	9.6	−47.0	10	10.5	−52.5	10	9.5	−46.8	17	10.1	−53.1	13	10.2	−55.3	8	9.8	−49.5
330–339	6	11.7	−62.3	19	11.0	−54.5	22	11.4	−58.0	17	11.5	−58.6	17	11.5	−58.6	12	11.2	−57.8	15	11.3	−56.3
340–349	5	12.5	−62.4	14	12.5	−60.6	13	13.0	−65.7	10	12.6	−62.7	10	12.4	−61.1	9	11.4	−56.3	6	12.4	−61.3
350–359	1	13.6	−67.0	8	12.8	−58.9	5	13.1	−61.4	6	13.6	−65.2	7	12.6	−58.1	2	12.8	−60.5	7	13.6	−63.6
360–369	1	12.2	−54.0	1	13.1	−56.0	3	13.3	−57.0	3	13.5	−60.7	3	12.8	−55.7	4	12.5	−56.0	1	13.8	−69.0
370–379				5	14.2	−60.2	1	14.4	−61.0				3	13.8	−58.3	3	13.1	−53.7	1	14.2	−58.0
380–389	1	15.0	−64.0	2	14.8	−59.5	1	14.2	−52.0	1	14.8	−58.0	4	14.3	−57.8						
390–399				1	15.4	−60.0				1	16.4	−70.0	1	15.2	−58.0	1	13.5	−48.0			
All (weighted means)		10.4	−58.8		11.6	−54.9		11.8	−58.0		11.5	−56.9		11.4	−56.0		10.2	−54.2		11.4	−56.5
Mean potential temperature	322.3			341.8			339.2			337.6			338.5			328.6			337.2		